

(19) World Intellectual Property Organization
International Bureau(43) International Publication Date
8 February 2001 (08.02.2001)

PCT

(10) International Publication Number
WO 01/09980 A3

(51) International Patent Classification⁷: H01L 21/66, G01R 1/067, 1/073

(21) International Application Number: PCT/US00/20748

(22) International Filing Date: 31 July 2000 (31.07.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data: 60/146,825 2 August 1999 (02.08.1999) US

(71) Applicant (for all designated States except US): GRYPH-
ICS, INC. [US/US]; Suite 140, 3850 Annapolis, Plymouth,
MN 55447 (US).

(71) Applicant and
(72) Inventor: RATHBURN, James, J. [US/US]; 5454 Pa-
genkopf Road, Maple Plain, MN 55359 (US).

(74) Agents: SCHWAPPACH, Karl, G. et al.; Faegre &
Benson, LLP, 2200 Wells Fargo Center, 90 South Seventh
Street, Minneapolis, MN 55402-3901 (US).

(81) Designated States (national): AE, AG, AL, AM, AT, AU,
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ,
DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR,
HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR,
LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ,
NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM,
TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

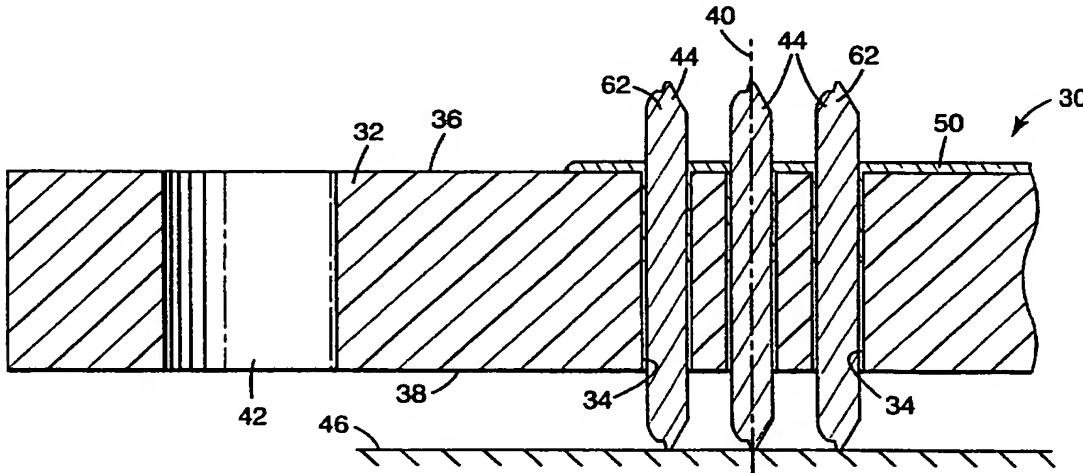
(84) Designated States (regional): ARIPO patent (GH, GM,
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian
patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European
patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE,
IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG,
CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report

(88) Date of publication of the international search report:
30 August 2001For two-letter codes and other abbreviations, refer to the "Guid-
ance Notes on Codes and Abbreviations" appearing at the begin-
ning of each regular issue of the PCT Gazette.

(54) Title: CONTROLLED COMPLIANCE FINE PITCH INTERCONNECT



WO 01/09980 A3

(57) Abstract: A method and apparatus for achieving a very fine pitch interconnect between a flexible circuit member and another circuit member with extremely co-planar electrical contacts that have a large range of compliance. An electrical interconnect assembly that can be used as a die-level test probe, a wafer probe, and a printed circuit probe is also disclosed. The second circuit member can be a printed circuit board, another flexible circuit, a bare-die device, an integrated circuit device, an organic or inorganic substrate, a rigid circuit and virtually any other type of electrical component. A plurality of electrical contacts are arranged in a housing. The electrical contacts may be arranged randomly or in a one or two-dimensional array. The housing acts as a receptacle to individually locate and generally align the electrical contacts, while preventing adjacent contacts from touching. The first ends of the electrical contacts are electrically coupled to a flexible circuit member. The electrical contacts are free to move along a central axis within the housing. The second ends of the electrical contacts are free to electrically couple with one or more second circuit members without the use of solder.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 00/20748

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01L21/66 G01R1/067 G01R1/073

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H01L G01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 252 916 A (SWART MARK A) 12 October 1993 (1993-10-12) column 6, line 20 -column 9, line 46; figures 1,2 ---	1,13, 15-17, 19,21, 26,28, 31,32,46
X	US 4 118 090 A (DEL MEI LUIGI GIOVANNI) 3 October 1978 (1978-10-03) column 1, line 4 -column 4, line 48; figures 1,2 ---	1,2, 8-28, 31-33, 38,44-48
Y	--- ---	4-7,25, 29,30, 34,40-43

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

23 March 2001

Date of mailing of the international search report

- 4. APR. 2001

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patenttaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Munnix, S

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 00/20748

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 410 260 A (KAZAMA TOSHIRO) 25 April 1995 (1995-04-25) figure 7 ---	1,2, 8-28, 31-33, 38,44-48
X	WO 98 13695 A (PRIMEYIELD SYSTEMS INC) 2 April 1998 (1998-04-02) page 6, line 13 -page 8, line 26; figures 2,3 ---	1,4,6-9, 16,22, 25,32, 40,41, 43,47
A	US 5 723 347 A (HIRANO TOSHIKI ET AL) 3 March 1998 (1998-03-03) figures 2,15 ---	5
Y	US 5 412 329 A (IINO SHINJI ET AL) 2 May 1995 (1995-05-02) figure 6 ---	4-7,25, 29,30, 34,40-43
A	EP 0 310 302 A (MINNESOTA MINING & MFG) 5 April 1989 (1989-04-05) figures 1,5 ---	29,30
X	US 5 521 519 A (FAURE LOUIS H ET AL) 28 May 1996 (1996-05-28) column 3, line 15 - line 62; figure 2 ---	35-37
A	US 5 299 090 A (BRADY KEVIN J ET AL) 29 March 1994 (1994-03-29) column 3, line 3 - line 10; figure 3 ---	35-37
A	US 5 637 539 A (HOFMANN WOLFGANG ET AL) 10 June 1997 (1997-06-10) column 1, line 5 - line 33 column 5, line 3 - line 36 figures 6,7,22 -----	35-37

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 00/20748

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.: because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.: because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. Claims Nos.: because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

1-2, 4-24, 25 (as far as it does NOT recite the features of claim 3),
26-38, 40-48

4. No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

The additional search fees were accompanied by the applicant's protest.
 No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-2, 8-24,
25 (as far as it recites the features of claim 2),
26-28, 31-33, 38, 44-48

Electrical connector and interconnect assembly, and method of manufacturing the same, where a plurality of elongated contact members are positioned along the central axis of through holes in a housing, with both ends of the contact members extending above a respective surface of the housing, and where a resilient member controls the movement of the contact members along their central axis, characterized in that the resilient member comprises a compliant material between a portion of the through holes and a portion of the respective contact members.

2. Claims: 3,
25 (as far as it recites the features of claim 3),
39

Electrical connector and interconnect assembly, and method of manufacturing the same, where a plurality of elongated contact members are positioned along the central axis of through holes in a housing, with both ends of the contact members extending above a respective surface of the housing, and where a resilient member controls the movement of the contact members along their central axis, characterized in that the resilient member comprises a compliant material surrounding a portion of the electrical contacts along a surface of the housing.

3. Claims: 4-7,
25 (as far as it recites the features of claims 4 to 6), 29-30, 34, 40-43

Electrical connector and interconnect assembly, and method of manufacturing the same, where a plurality of elongated contact members are positioned along the central axis of through holes in a housing, with both ends of the contact members extending above a respective surface of the housing, and where a resilient member controls the movement of the contact members along their central axis, characterized in that the resilient member comprises a flexible circuit member.

4. Claims: 35-37

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Method of manufacturing an electrical interconnect assembly, where a plurality of elongated contact members are positioned along the central axis of through holes in a housing, with both ends of the contact members extending above a respective surface of the housing, and where the contact members are retained in the through holes, characterized in that a solder mask is applied to a surface of the housing, and that then the solder mask is planarized together with the contact members.

INTERNATIONAL SEARCH REPORT
Information on patent family members
International Application No
PCT/US 00/20748

Patent document cited in search report	Publication date	Patent family member(s)			Publication date
US 5252916	A 12-10-1993	US 5389885 A	14-02-1995		
		WO 9315409 A	05-08-1993		
		US 5447442 A	05-09-1995		
US 4118090	A 03-10-1978	ZA 7703036 A	30-08-1978		
US 5410260	A 25-04-1995	JP 2532331 B	11-09-1996		
		JP 6148236 A	27-05-1994		
WO 9813695	A 02-04-1998	EP 0928422 A	14-07-1999		
US 5723347	A 03-03-1998	JP 2710544 B	10-02-1998		
		JP 7113842 A	02-05-1995		
		US 5625298 A	29-04-1997		
		EP 0646800 A	05-04-1995		
US 5412329	A 02-05-1995	JP 2966671 B	25-10-1999		
		JP 5218150 A	27-08-1993		
		KR 196195 B	15-06-1999		
EP 0310302	A 05-04-1989	US 4859189 A	22-08-1989		
		CA 1289681 A	24-09-1991		
		DE 3851932 D	01-12-1994		
		DE 3851932 T	24-05-1995		
		JP 1121776 A	15-05-1989		
		KR 9703521 B	18-03-1997		
US 5521519	A 28-05-1996	US 5600883 A	11-02-1997		
		US 5718040 A	17-02-1998		
US 5299090	A 29-03-1994	CA 2123287 A,C	30-12-1994		
		DE 69406201 D	20-11-1997		
		DE 69406201 T	19-02-1998		
		EP 0632498 A	04-01-1995		
		JP 7321259 A	08-12-1995		
US 5637539	A 10-06-1997	NONE			

(19) World Intellectual Property Organization
International Bureau(43) International Publication Date
8 February 2001 (08.02.2001)

PCT

(10) International Publication Number
WO 01/09980 A2(51) International Patent Classification⁷:

H01R

(74) Agents: SCHWAPPACH, Karl, G. et al.; Faegre & Benson, LLP, 2200 Wells Fargo Center, 90 South Seventh Street, Minneapolis, MN 55402-3901 (US).

(21) International Application Number: PCT/US00/20748

(22) International Filing Date: 31 July 2000 (31.07.2000)

(81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(25) Filing Language: English

(26) Publication Language: English

(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

(30) Priority Data:

60/146,825 2 August 1999 (02.08.1999) US

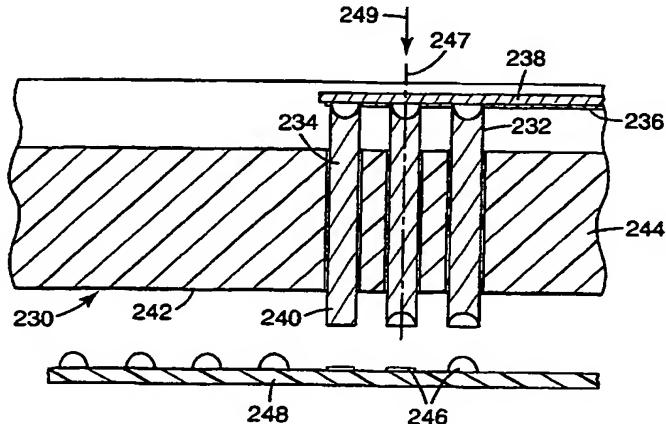
(71) Applicant (for all designated States except US): GRAPH-
ICS, INC. [US/US]; Suite 140, 3850 Annapolis, Plymouth,
MN 55447 (US).

Published:

— Without international search report and to be republished upon receipt of that report.

[Continued on next page]

(54) Title: CONTROLLED COMPLIANCE FINE PITCH INTERCONNECT



WO 01/09980 A2

(57) Abstract: A method and apparatus for achieving a very fine pitch interconnect between a flexible circuit member and another circuit member with extremely co-planar electrical contacts that have a large range of compliance. An electrical interconnect assembly that can be used as a die-level test probe, a wafer probe, and a printed circuit probe is also disclosed. The second circuit member can be a printed circuit board, another flexible circuit, a bare-die device, an integrated circuit device, an organic or inorganic substrate, a rigid circuit and virtually any other type of electrical component. A plurality of electrical contacts are arranged in a housing. The electrical contacts may be arranged randomly or in a one or two-dimensional array. The housing acts as a receptacle to individually locate and generally align the electrical contacts, while preventing adjacent contacts from touching. The first ends of the electrical contacts are electrically coupled to a flexible circuit member. The electrical contacts are free to move along a central axis within the housing. The second ends of the electrical contacts are free to electrically couple with one or more second circuit members without the use of solder.

WO 01/09980 A2



For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

1/19

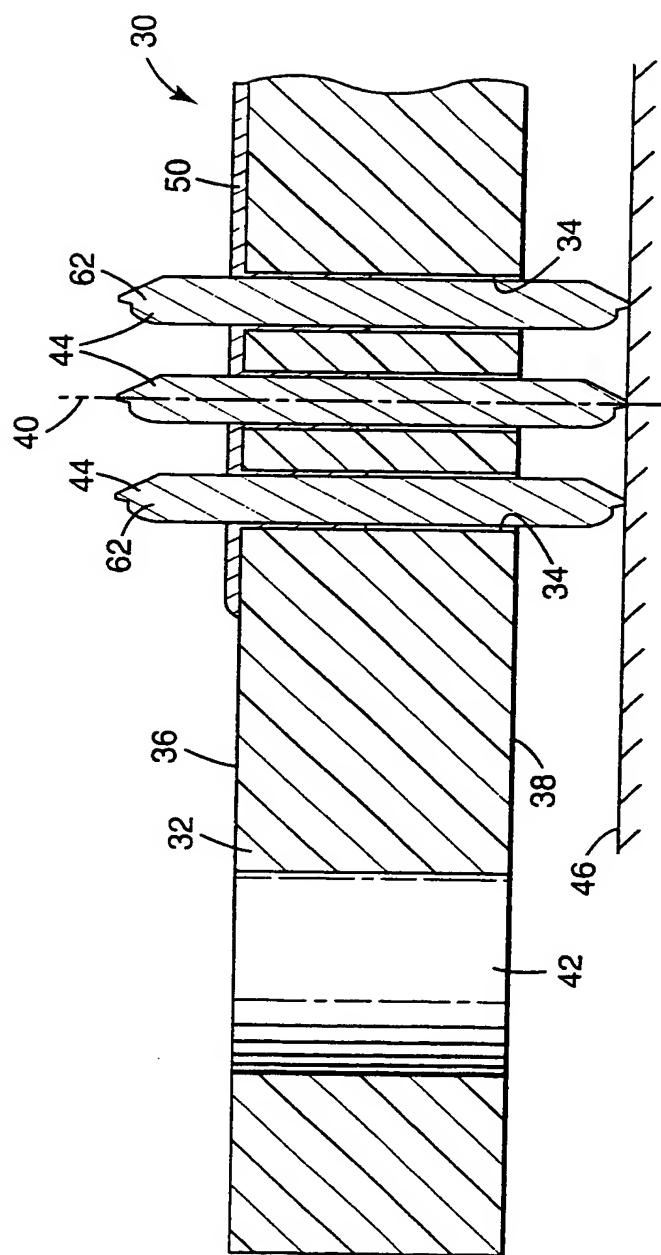


Fig. 1

2/19

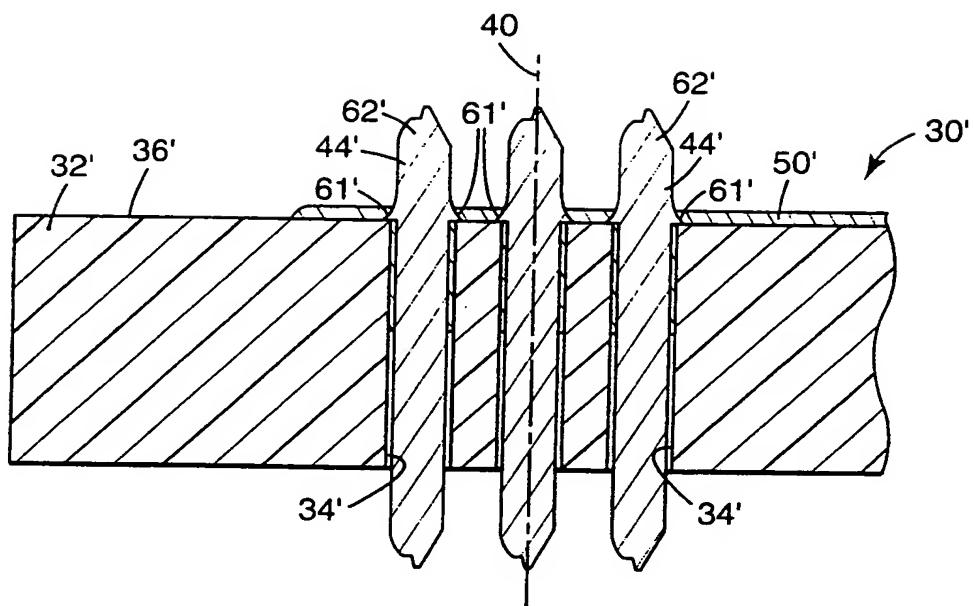


Fig. 1A

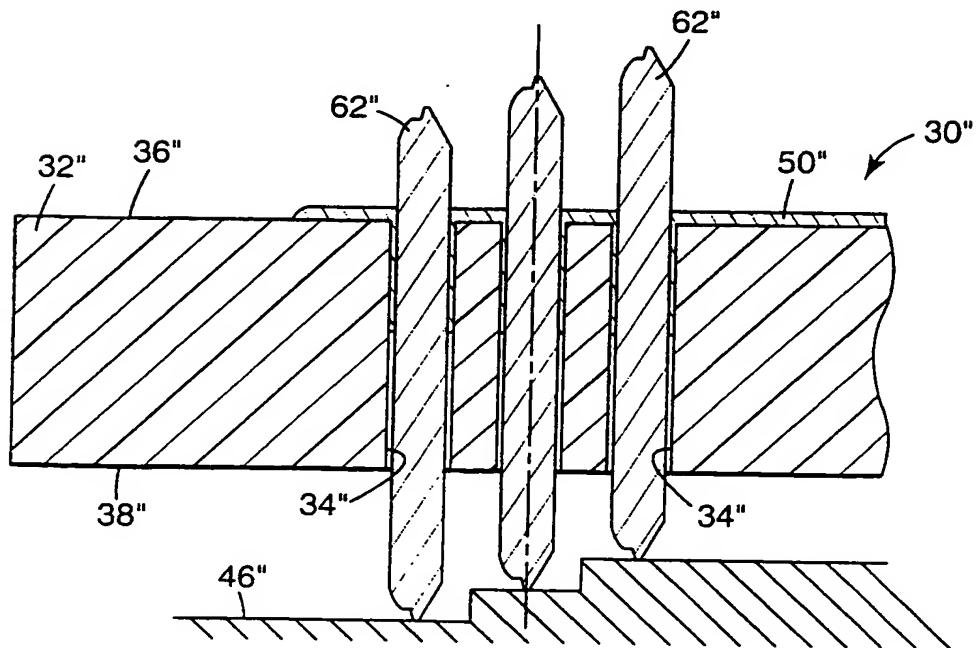


Fig. 1B

3/19

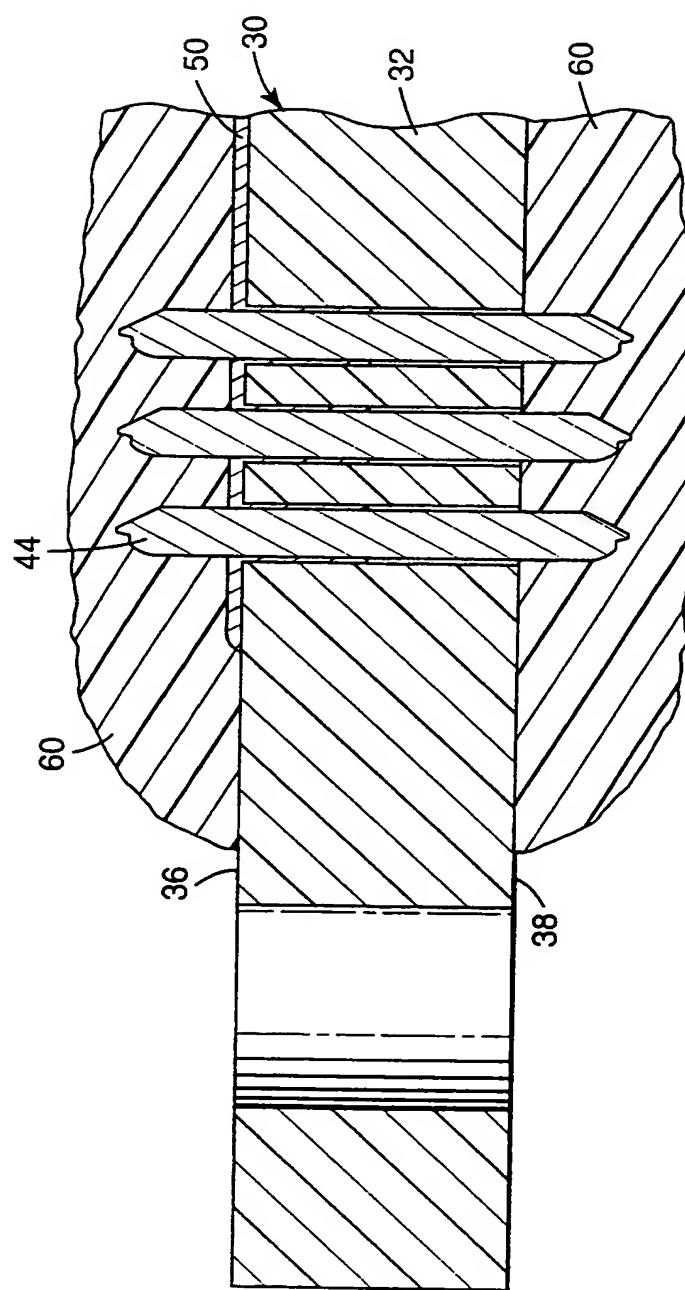


Fig. 2

4/19

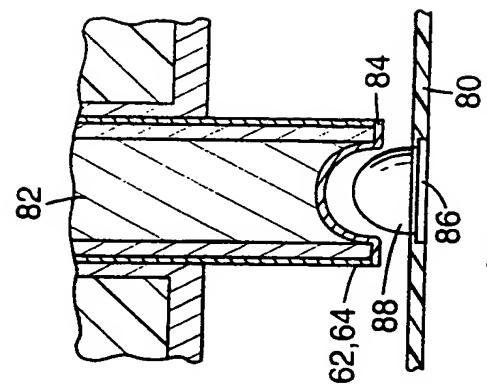
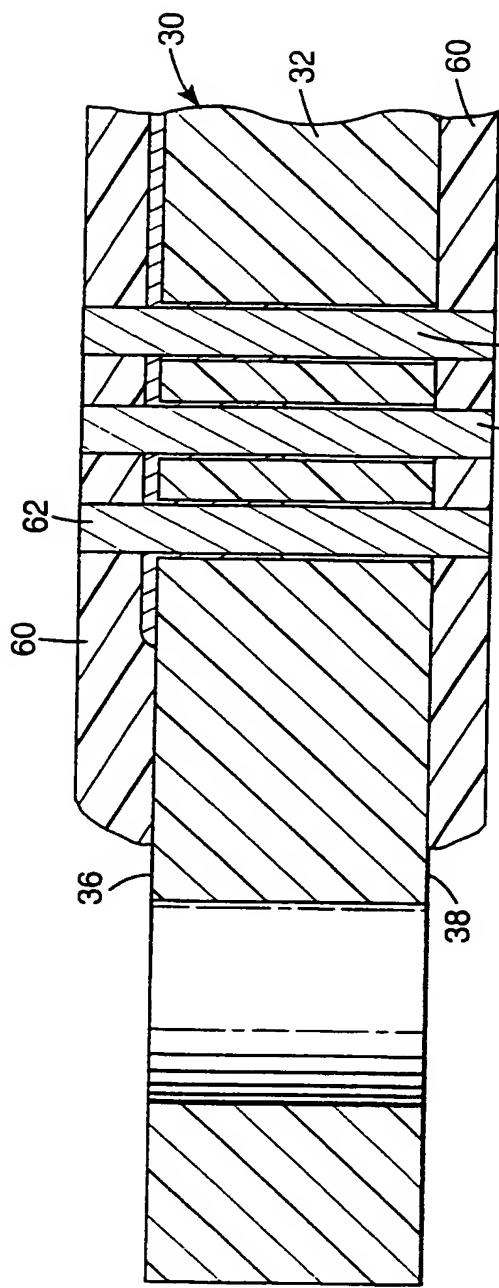


Fig. 5

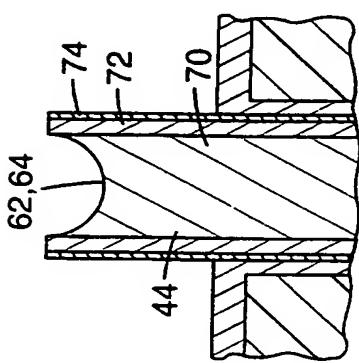
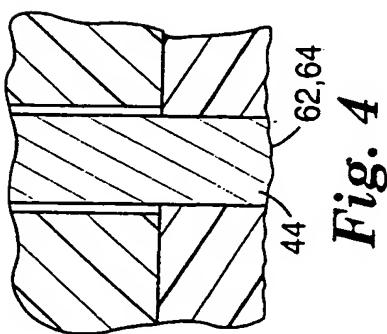


Fig. 6



5/19

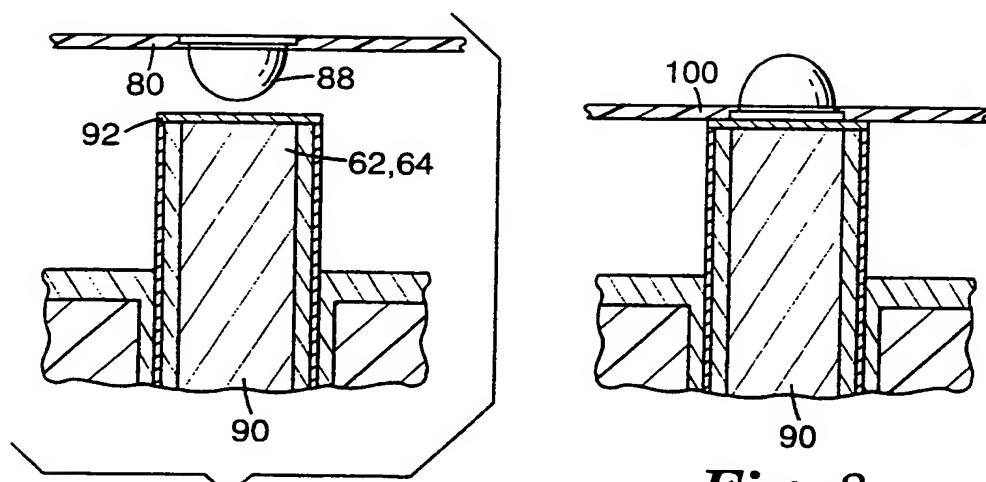


Fig. 7

Fig. 8

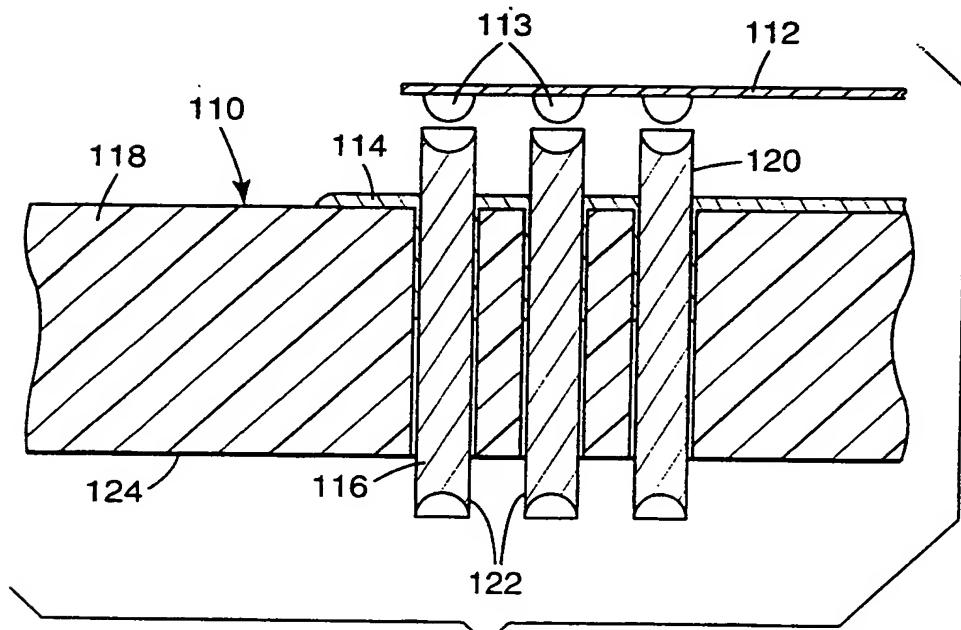


Fig. 9

6/19

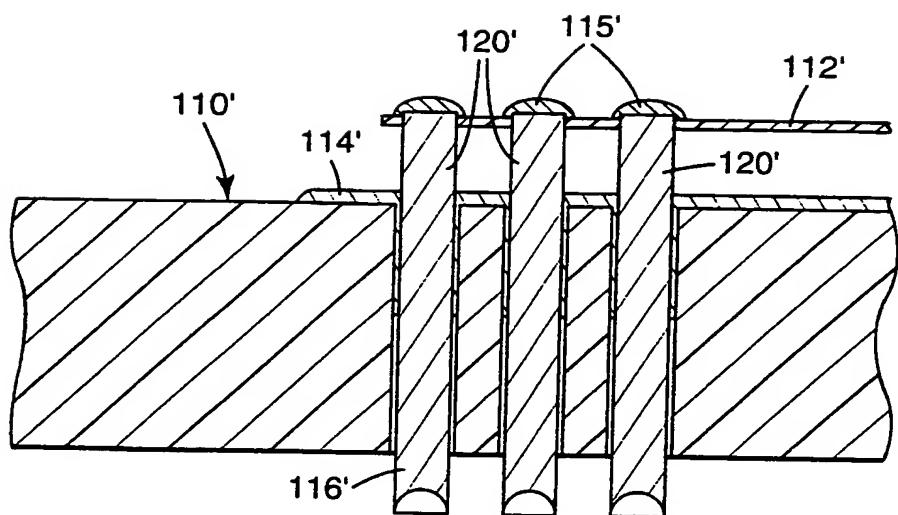


Fig. 9A

7/19

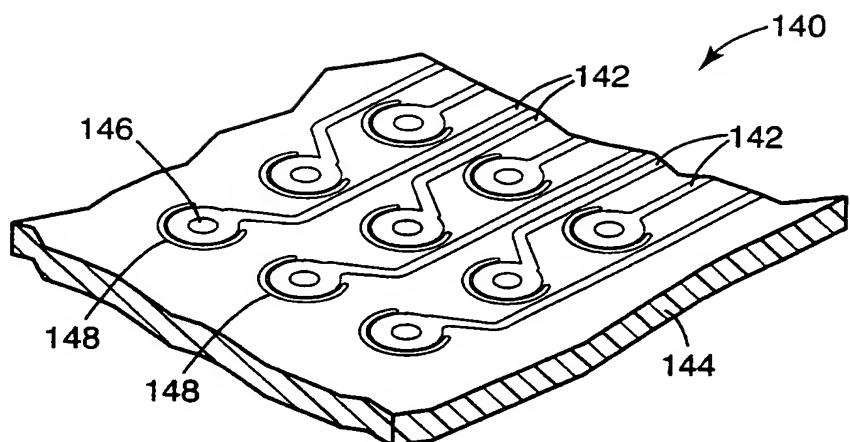


Fig. 10

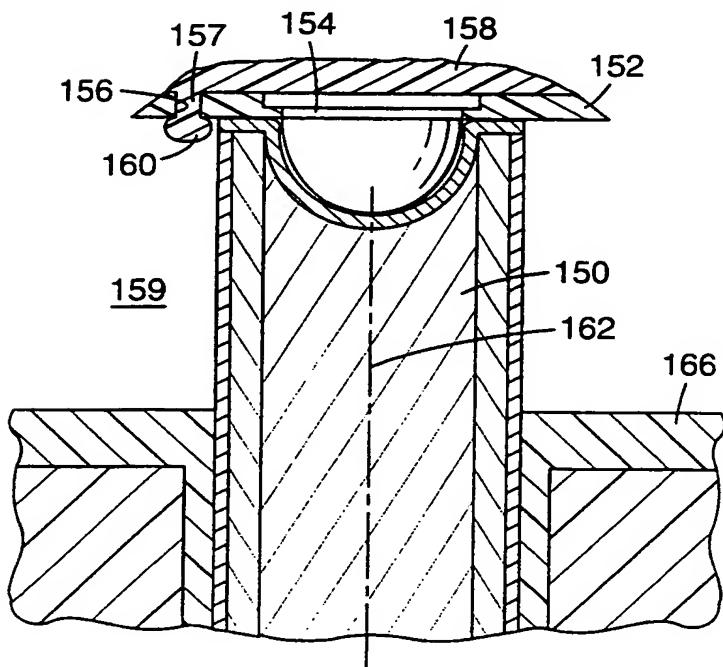


Fig. 11

8/19

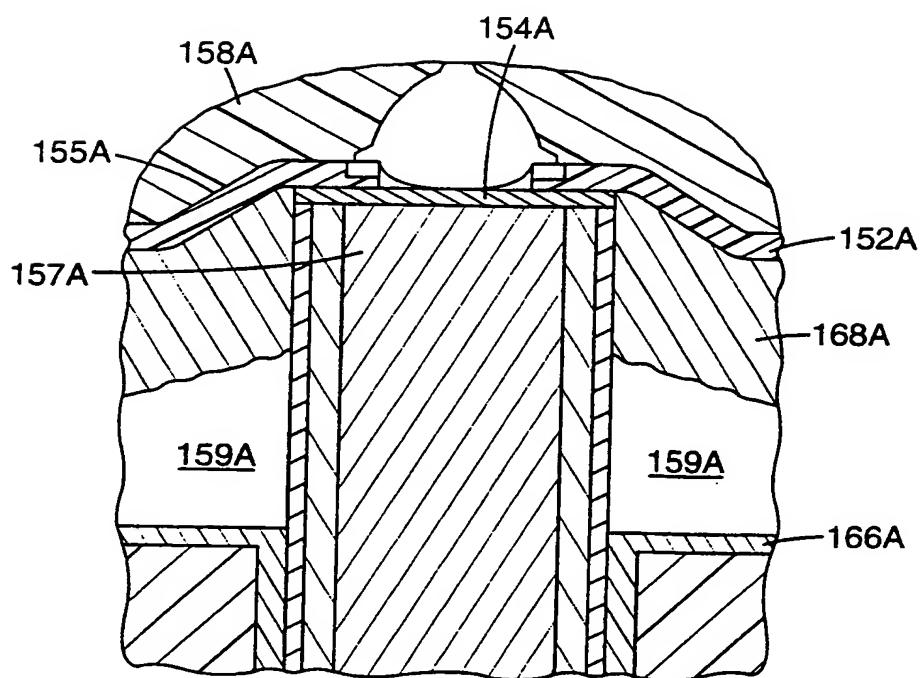


Fig. 11A

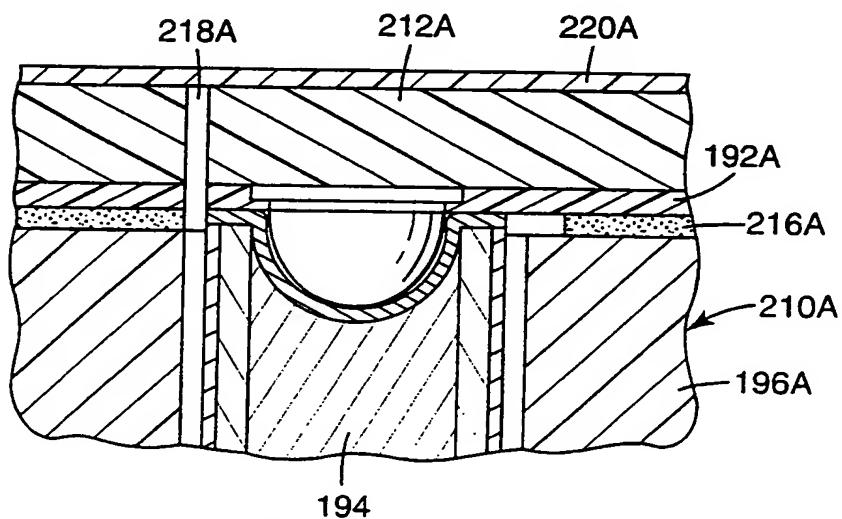


Fig. 15A

9/19

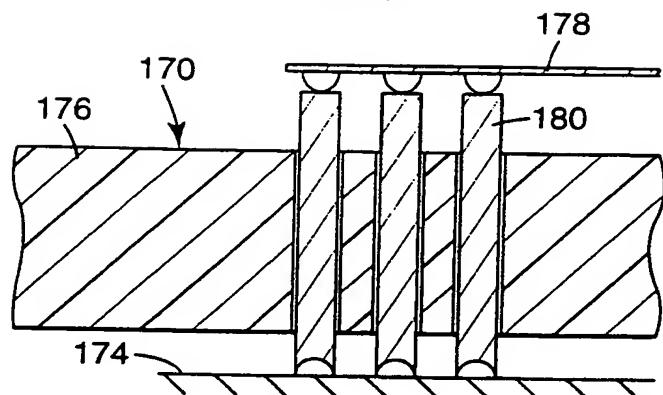


Fig. 12

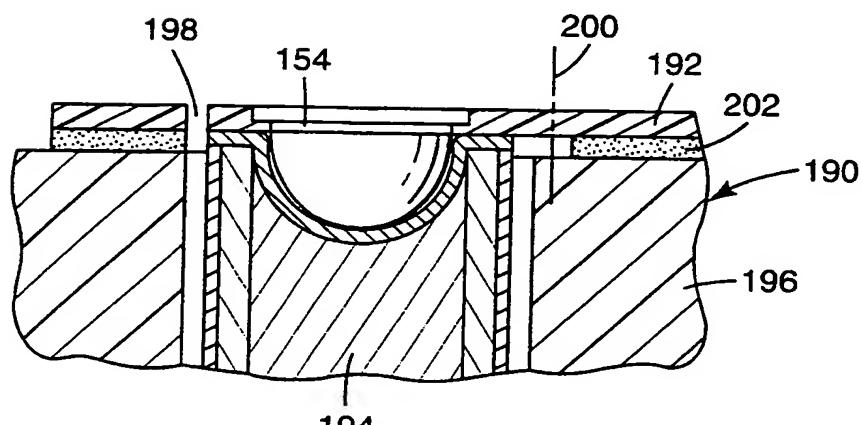


Fig. 13

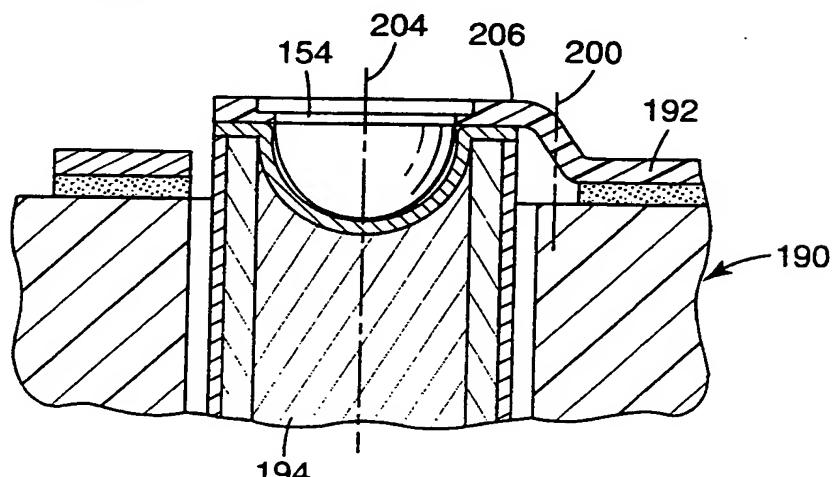


Fig. 14

10/19

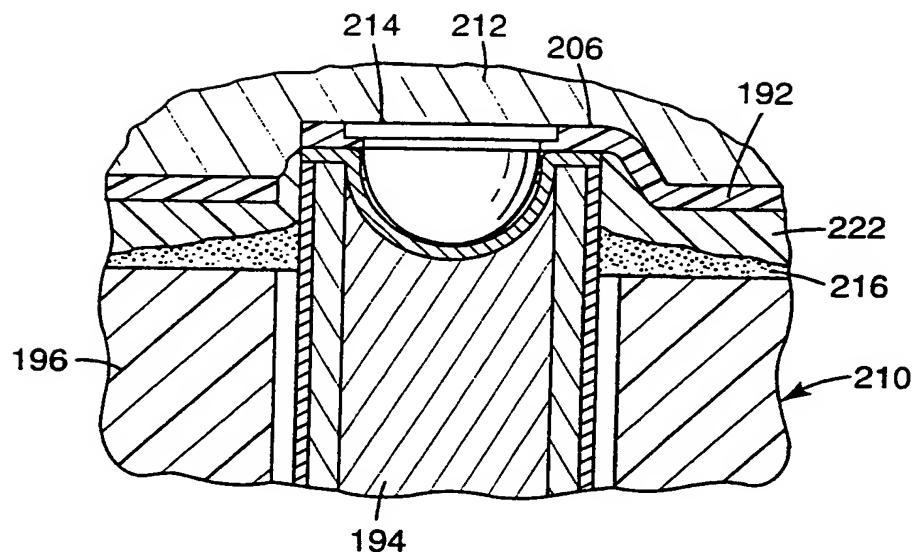


Fig. 15

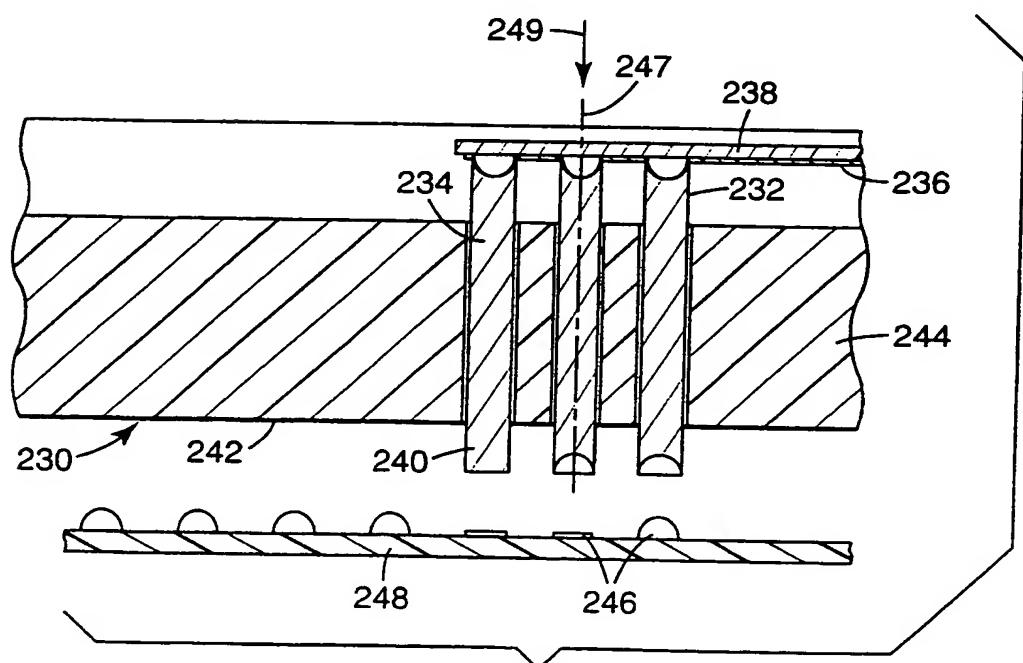


Fig. 16

11/19

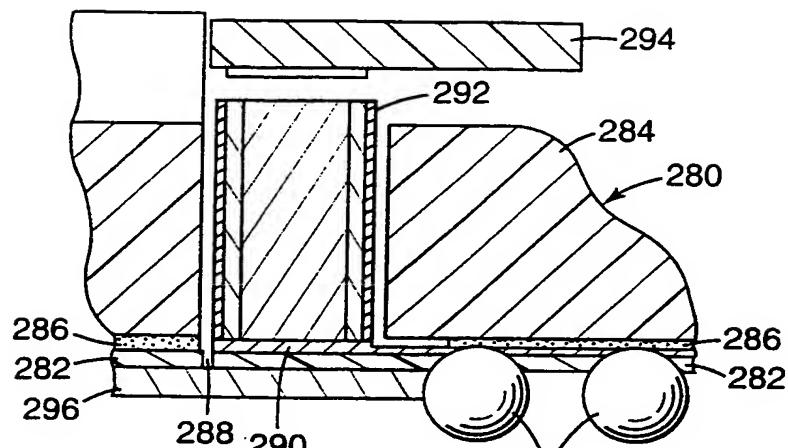


Fig. 17

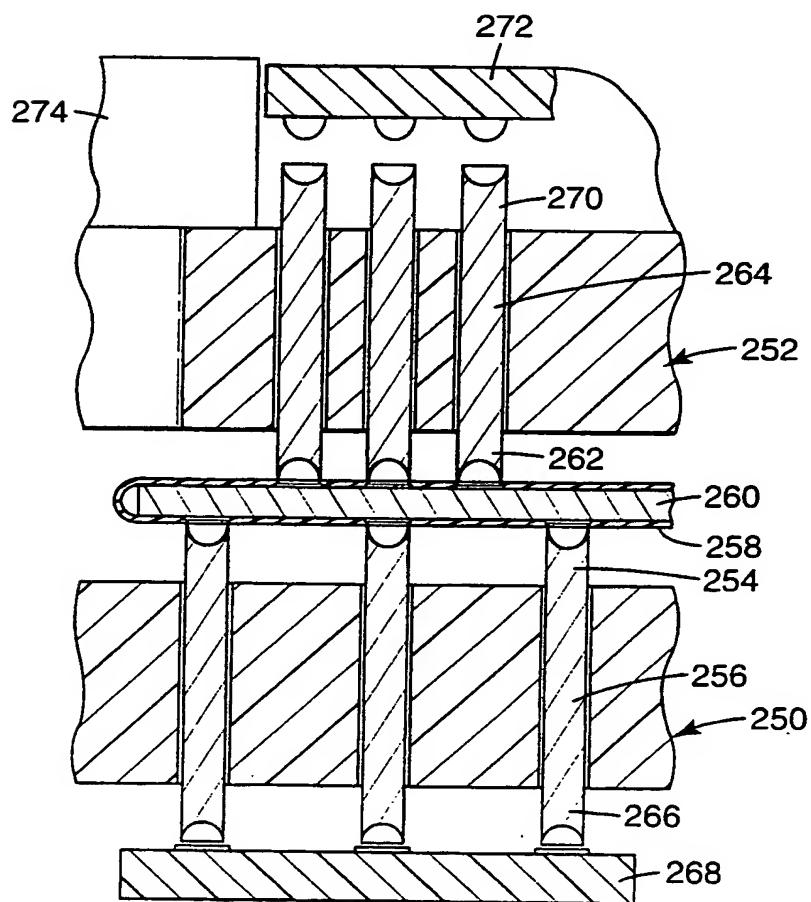


Fig. 18

12/19

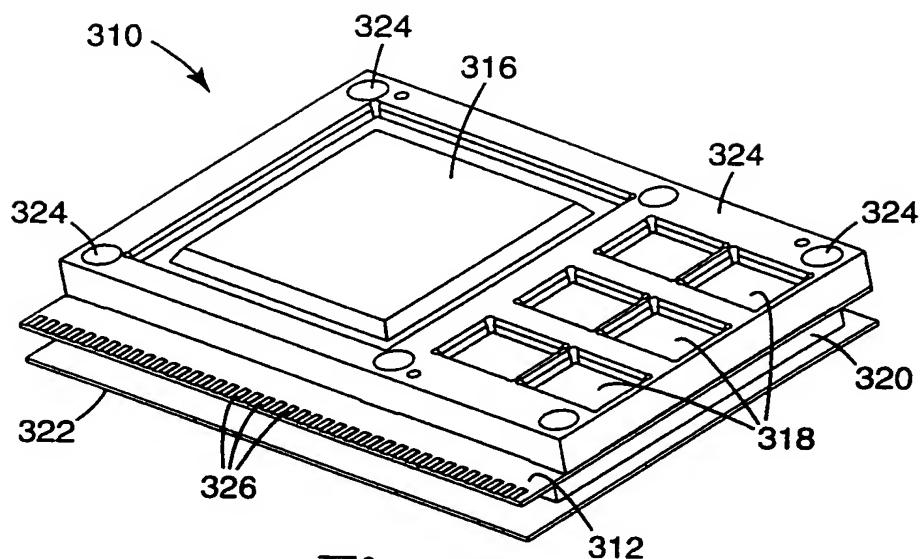


Fig. 19

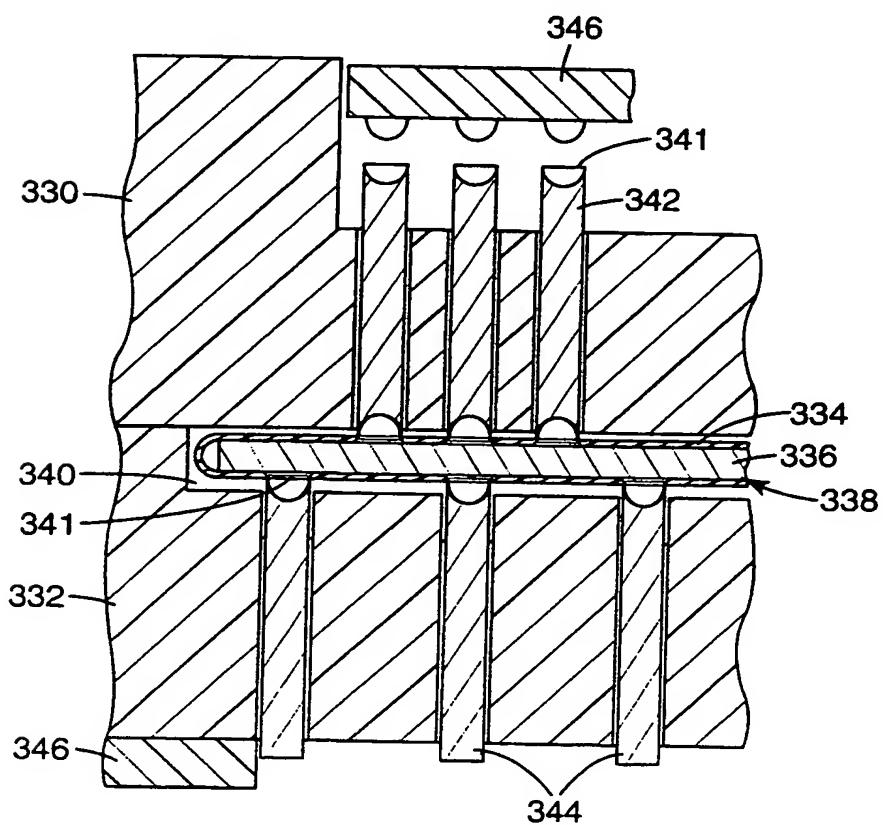


Fig. 20

13/19

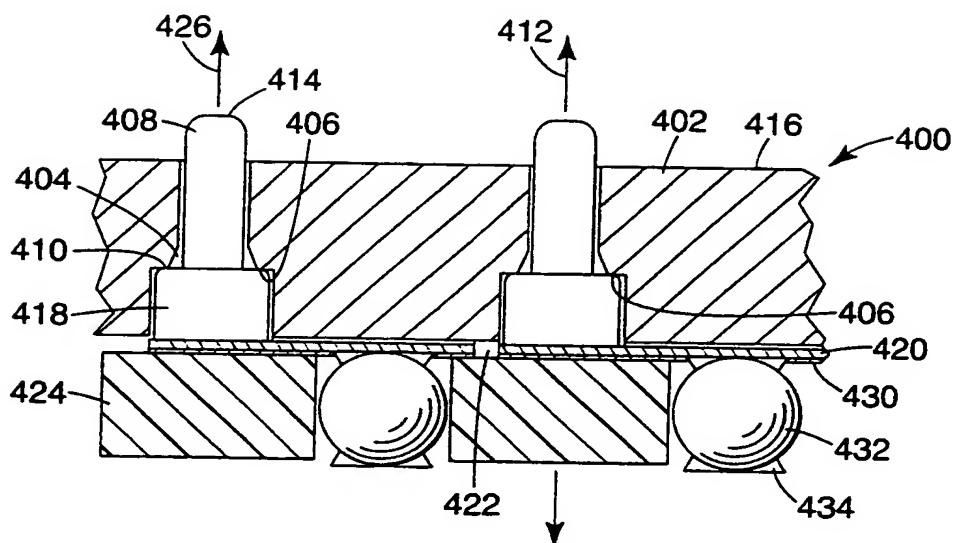


Fig. 21

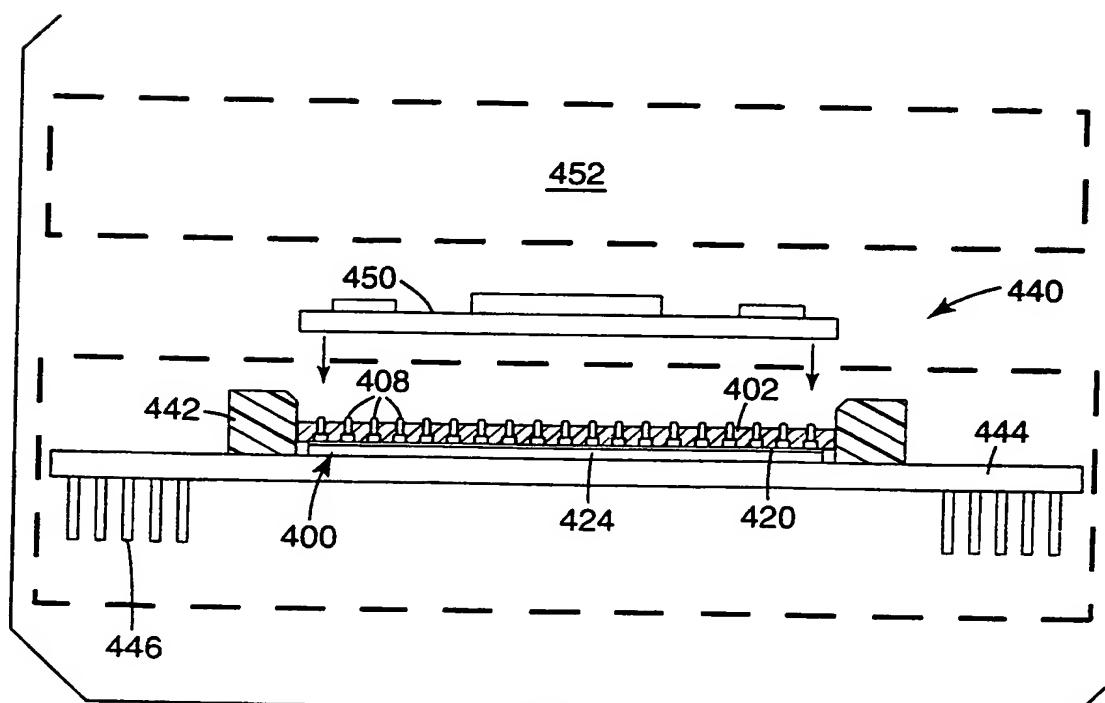
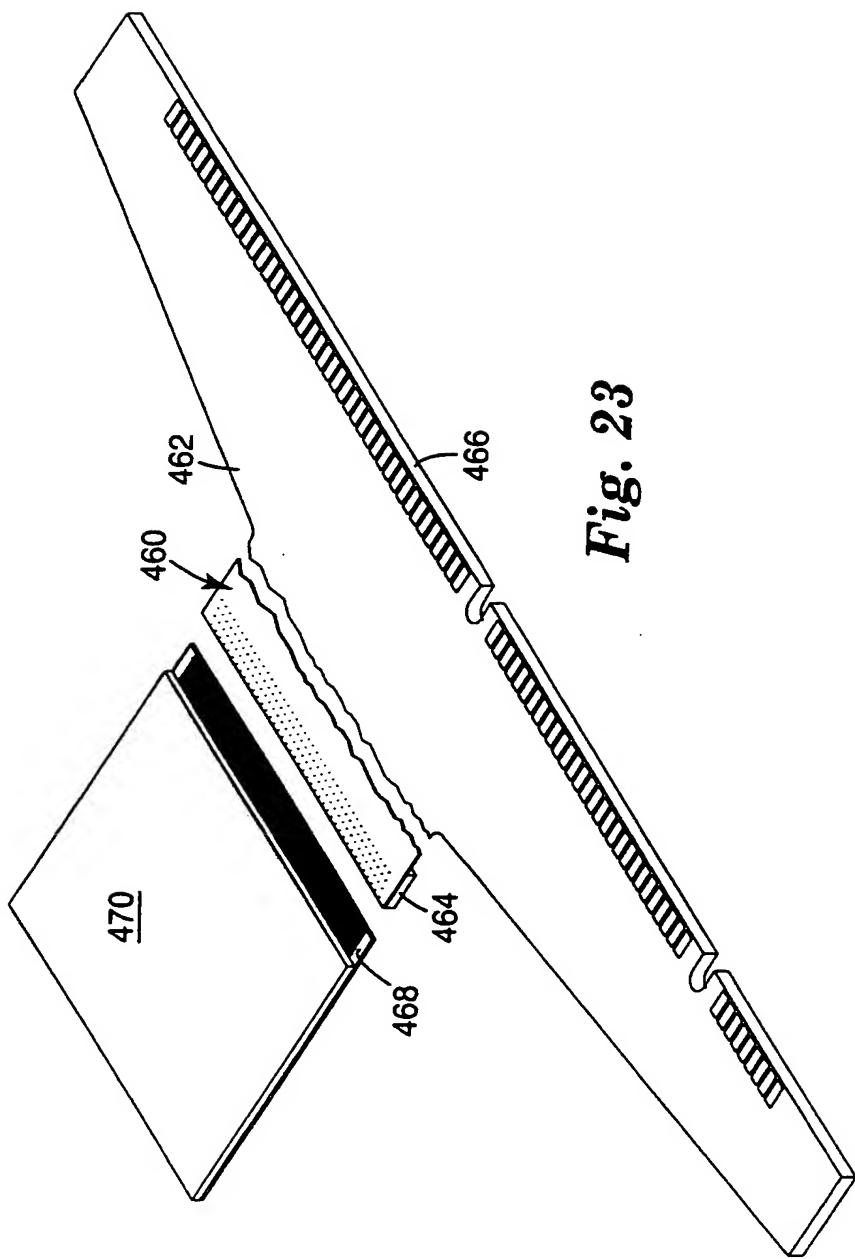


Fig. 22

14/19



15/19

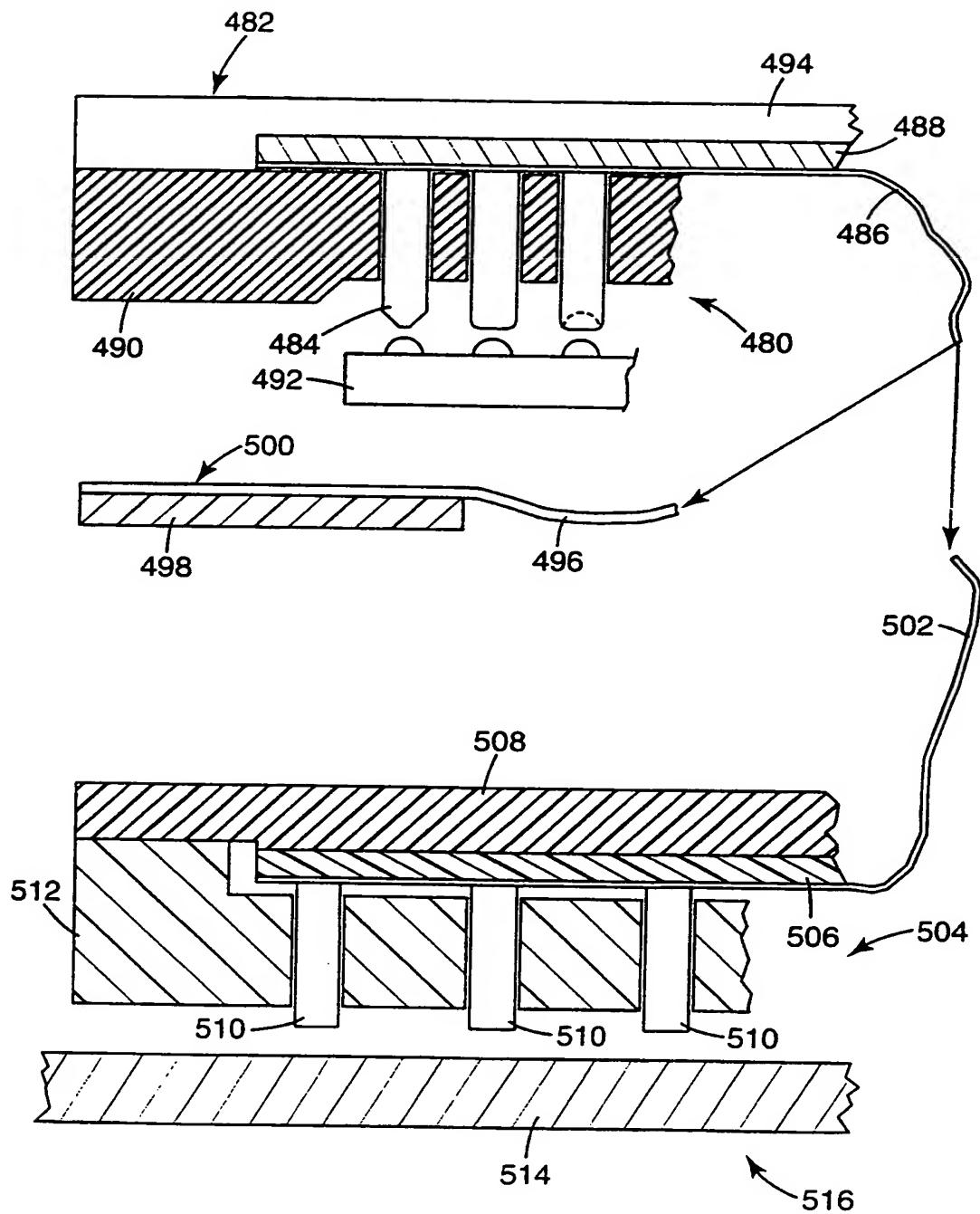


Fig. 24

16/19

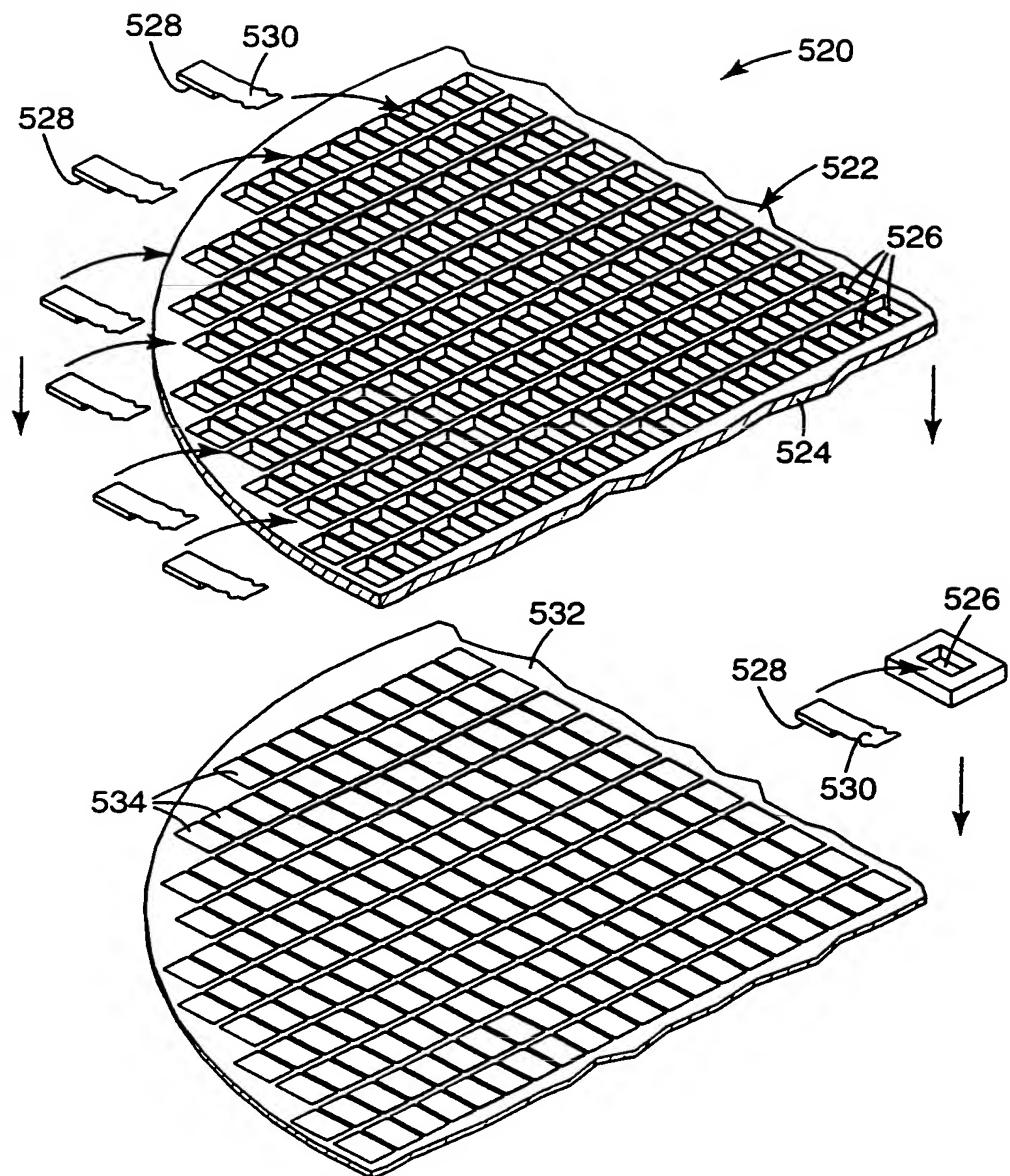


Fig. 25

17/19

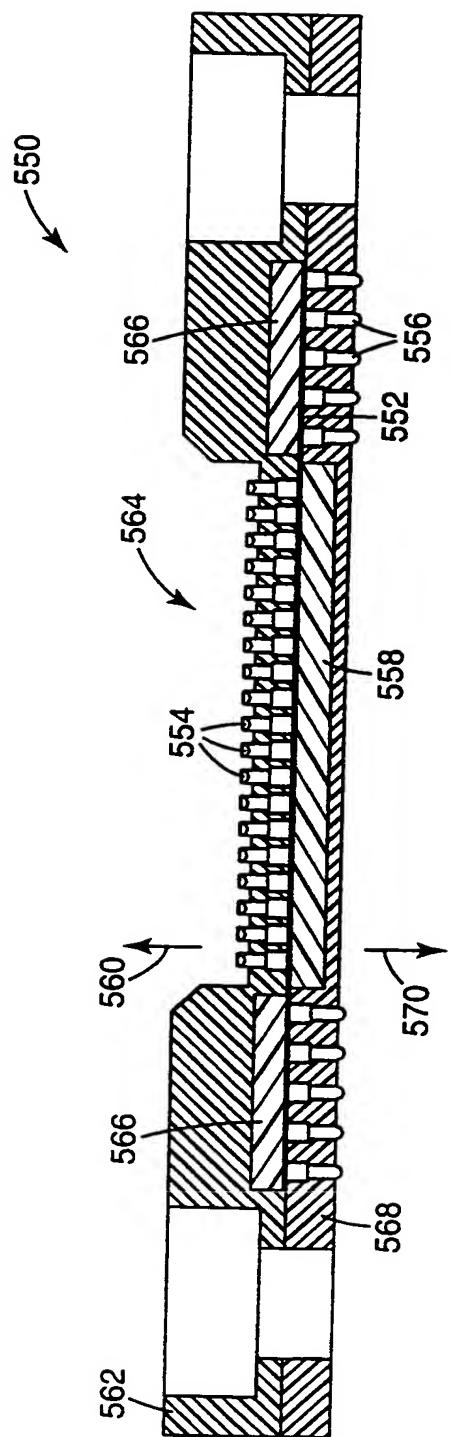


Fig. 26

18/19

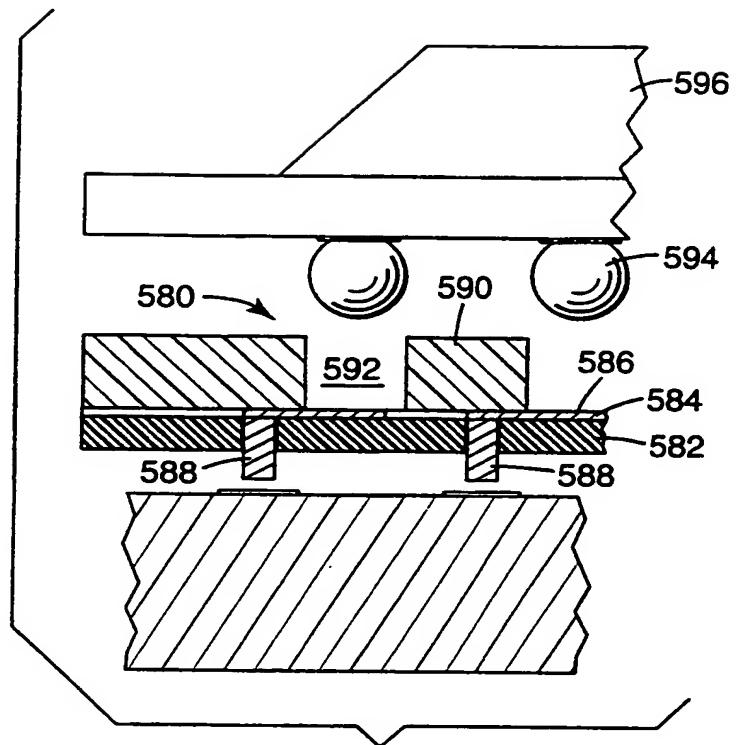


Fig. 27A

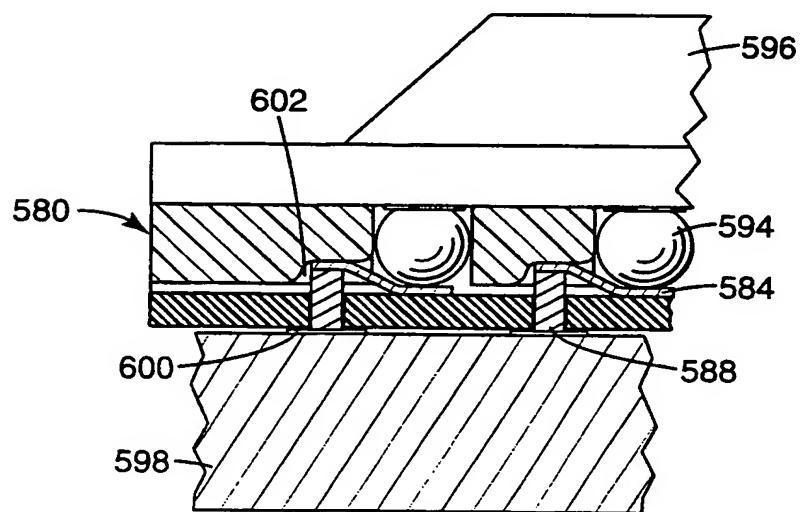


Fig. 27B

19/19

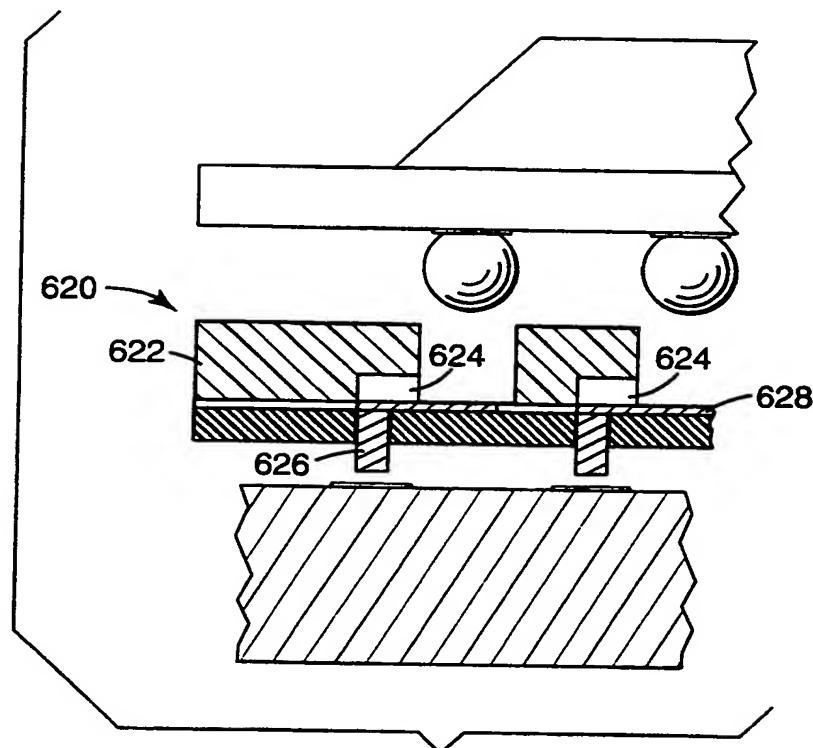


Fig. 28A

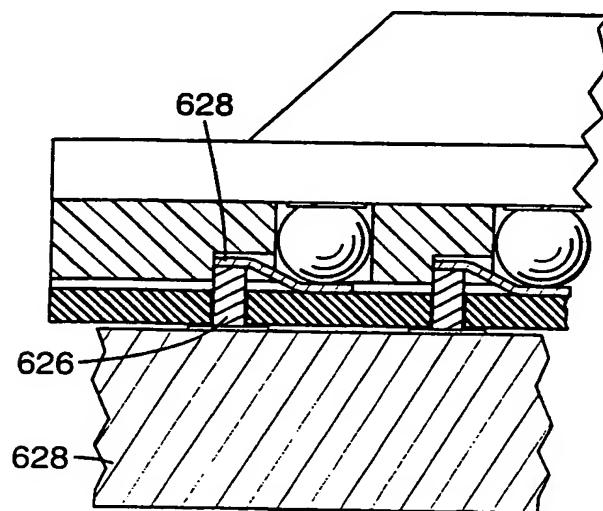


Fig. 28B